The ESA Science Program for the progress of European society

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Basics of the Science Programme

- **The Programme is Science-driven:**
  both long-term science planning and mission calls are bottom-up processes, relying on broad community input and peer review.

- **The Programme is Mandatory:**
  all member states contribute pro-rata to GDP providing budget stability, allowing long-term planning of its scientific goals and being the backbone of the Agency.

HORIZON 2000 (1986-2005)

ROSETTA

INTEGRAL

Planck

HERSCHEL

Mars Express

Smart 1,
Venus Express,

Double Star
Suzaku

ISO

Huygens

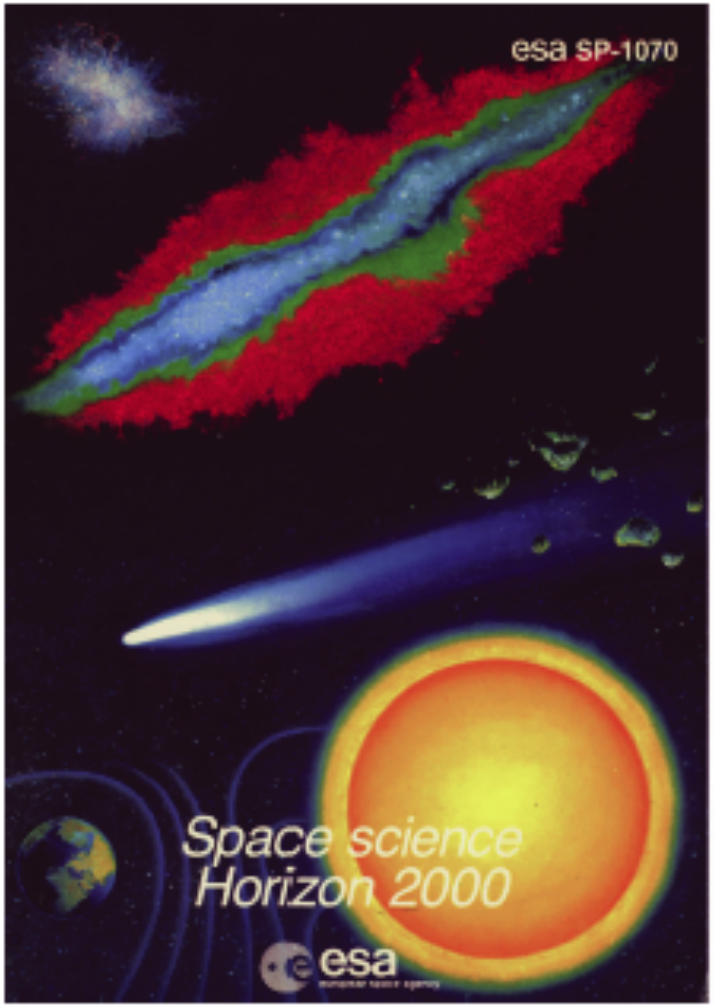
HST

STSP: SOHO
& CLUSTER

Ulysses

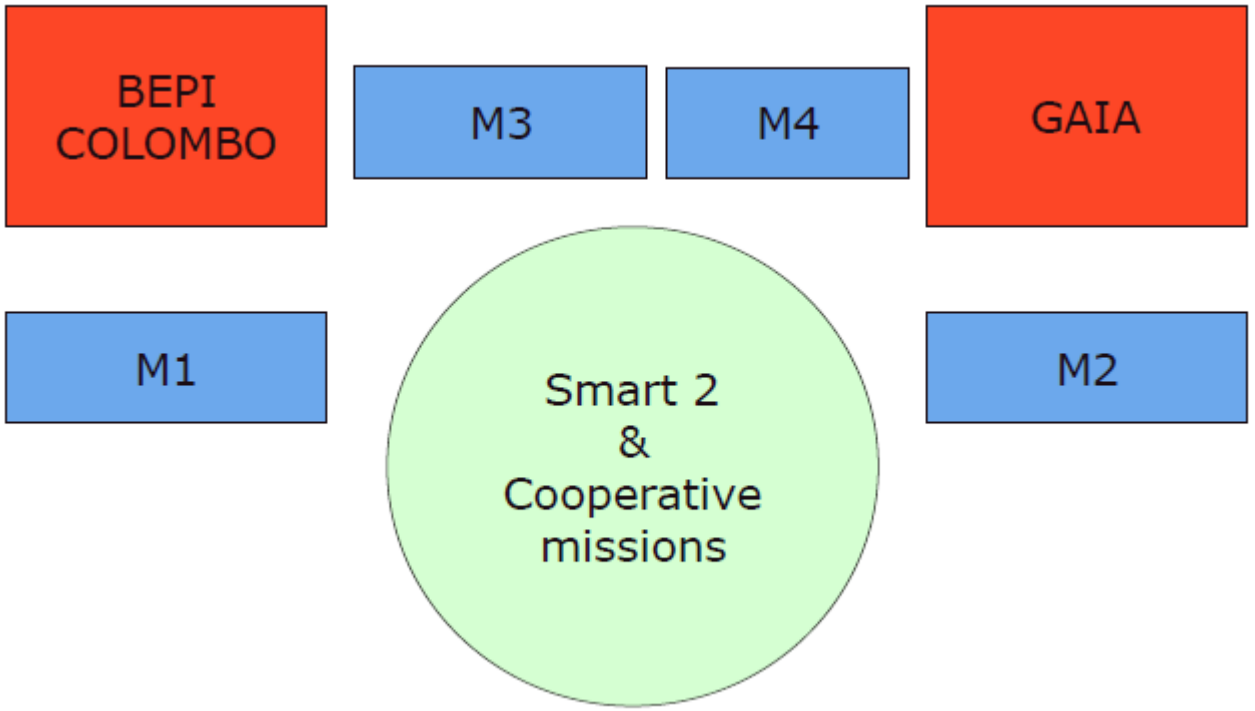
HIPPARCOS

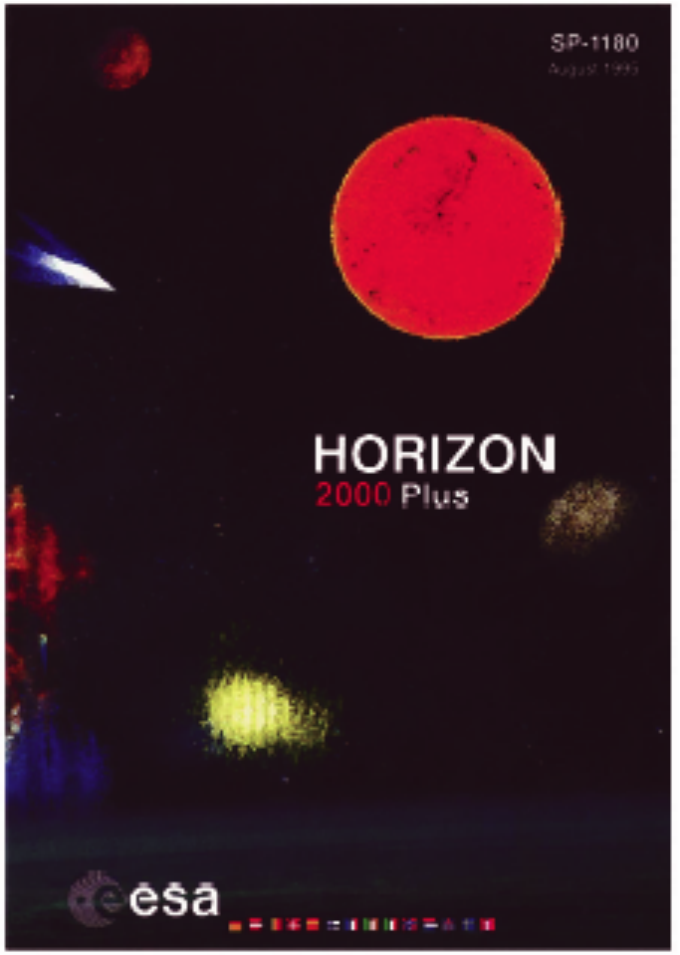
XMM-Newton



HORIZON 2000+ (2006-2015)

In 1995, a roll-forward of the programme was established, with the name Horizon 2000+, for 10 additional years, i.e. with launches up to 2015.





HORIZON 2000+ (2005-2015)

BEPI COLOMBO

LISA PF

JWST

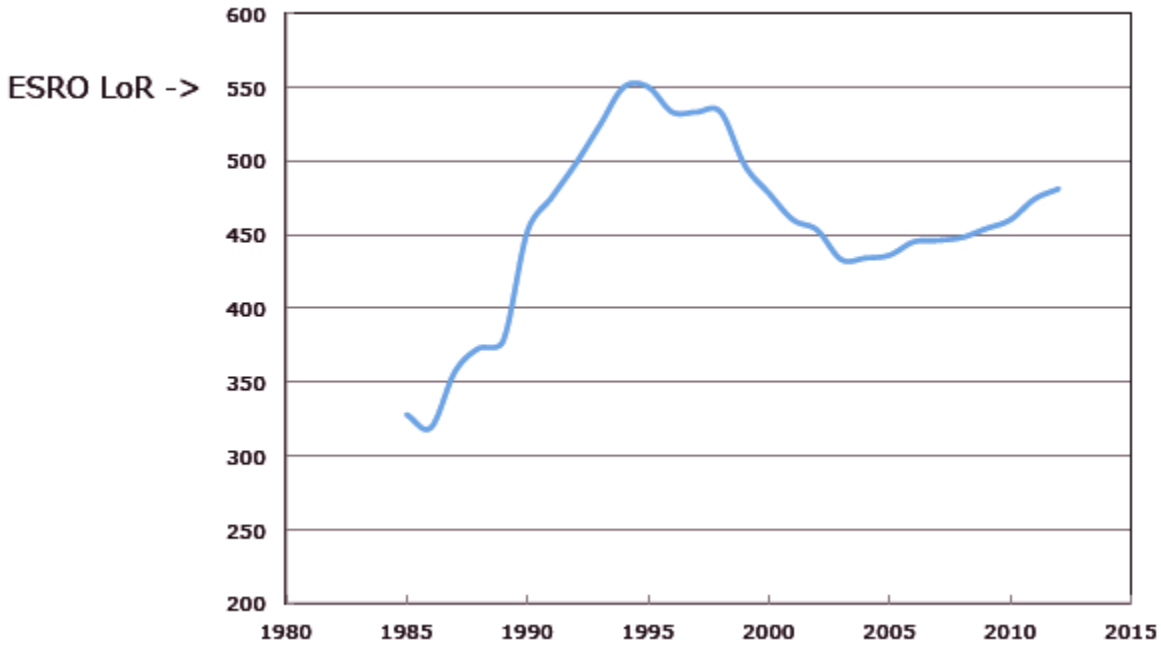
Missions Extensions

GAIA

CoRot, Akari, Hinode, Chandrayaan, Proba 2

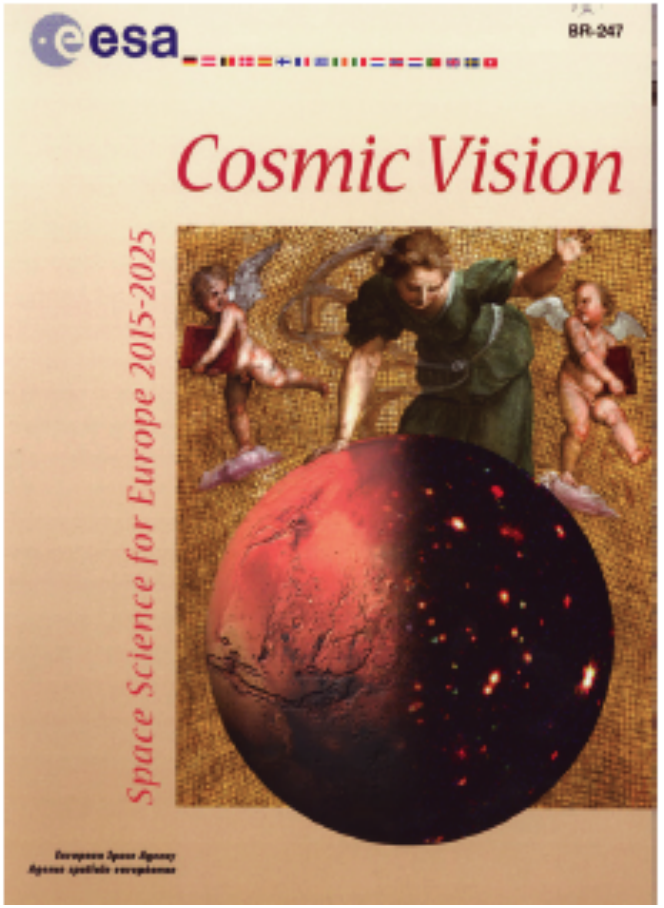
PLANCK

HERSCHEL



COSMIC VISION

In 2005, a new programme was introduced to replace H2000+, for one more decade (until 2025) with the name Cosmic Vision (2015-2025).



COSMIC VISION

- Only a decade was considered (2015-2025)
- Scientific themes, rather than missions, selected in consultation with the scientific community
- Call for Science Themes in Spring 2004
  - Open to whole community, no limitations
  - Responses analyzed by the Advisory Structure
- Workshop with community in Paris in September 2004
- Cosmic Vision Plan presented to the community in Spring 2005

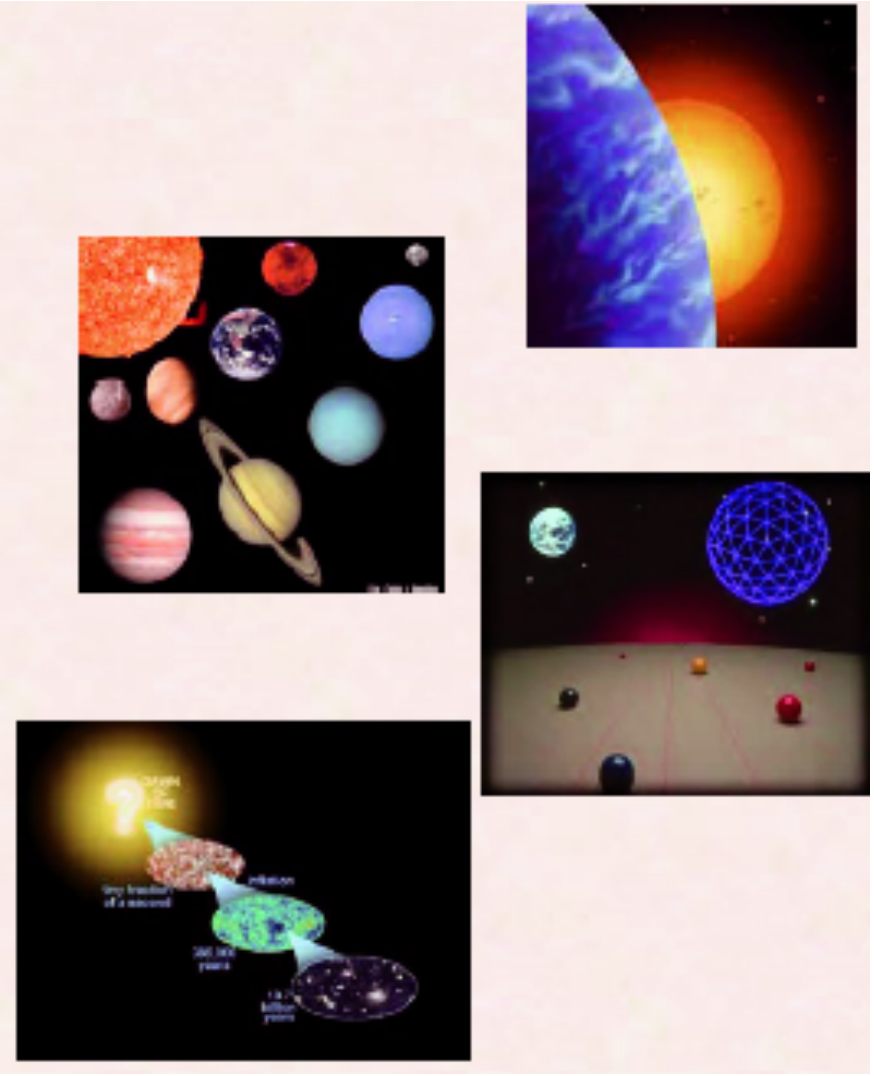
The COSMIC VISION “Grand Themes”

1. What are the conditions for planetary formation and the emergence of life ?

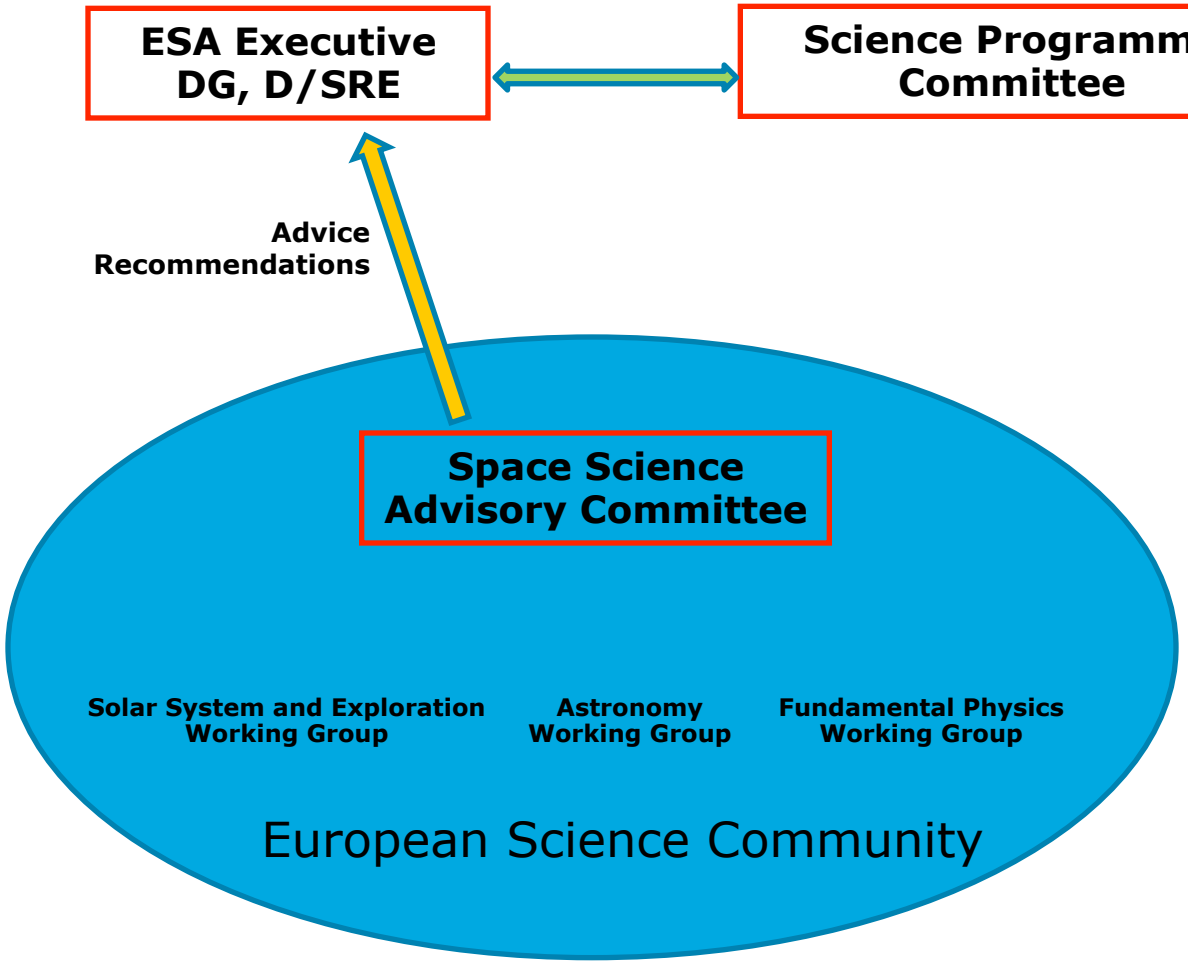
2. How does the Solar System work?

3. What are the physical fundamental laws of the Universe?

4. How did the Universe originate and what is it made of?



COSMIC VISION – A bottom-up approach

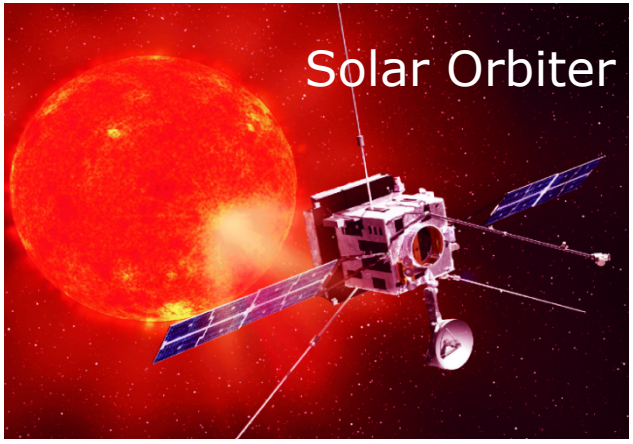


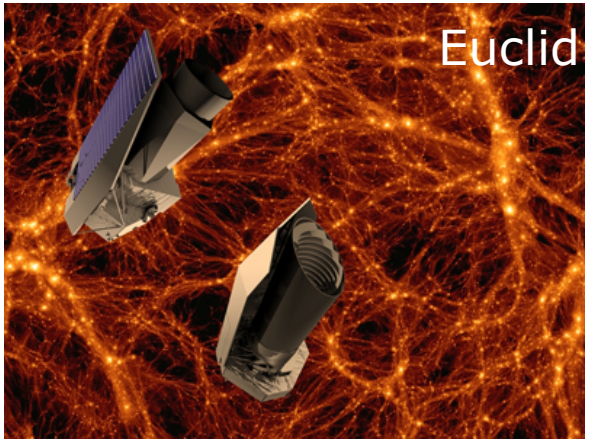
- First "Call for Missions" issued in 1st Q 2007.
- Both L and M mission proposals solicited.
- More than 50 proposals received.

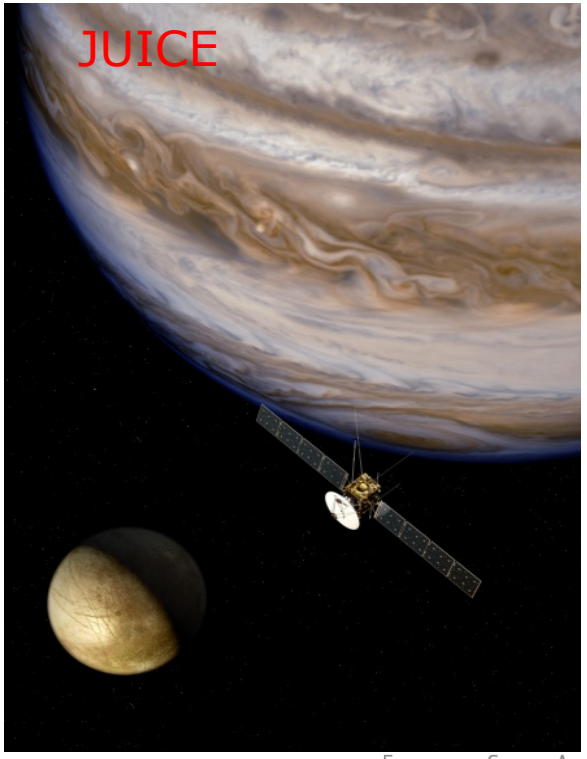
COSMIC VISION – Step 1

- Proposal selection for assessment phase in October 2007
  - 3 M missions concepts: Euclid, PLATO, Solar Orbiter
  - 3 L mission concepts: X-ray astronomy, Jupiter system science, gravitational wave observatory
  - 1 MoO being considered: European participation to SPICA

- Selection of Solar Orbiter as M1 and Euclid as M2 in 2011.
- Selection of Juice as L1 in 2012.

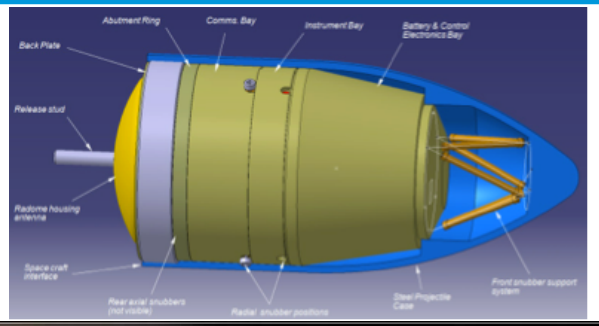


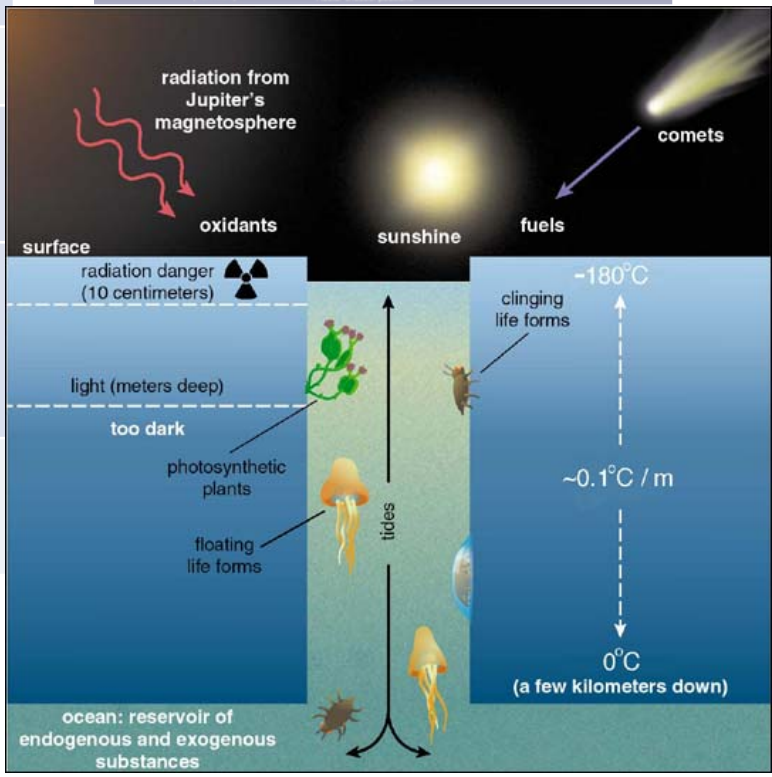




ESA Study on Europa Penetrators

Science Objectives	Priority at Ganymede 1-highest 3-lowest	Priority at Europa 1-highest 3-lowest
1. Astrobiology of surface and sub-surface	3	1
2. Chemical composition	2	1
3. Geophysics: confirm existence of and determine ice depth to moon's ocean	2	2
4. Geophysics: Characterise surface physical properties, and if possible their variation with depth	3	3
5. Geophysics: determine additional constraints in interior structure	2	3

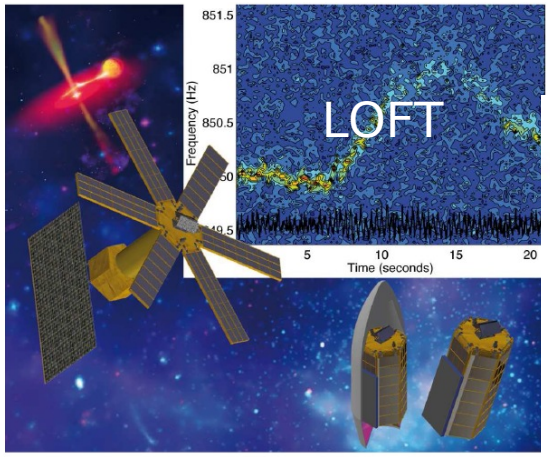


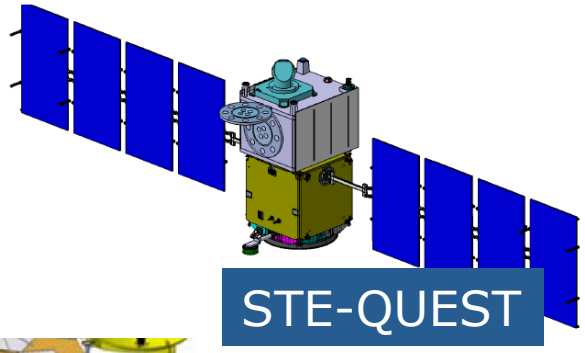


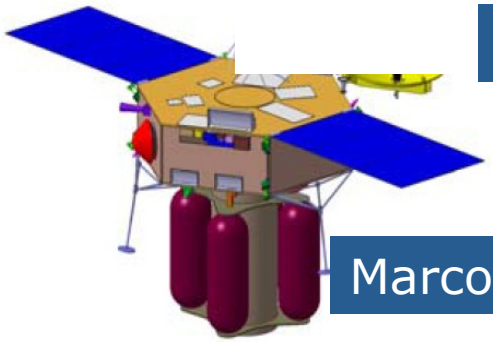
Europa surface and subsurface ocean habitats *(Greenberg et al. 2002)*

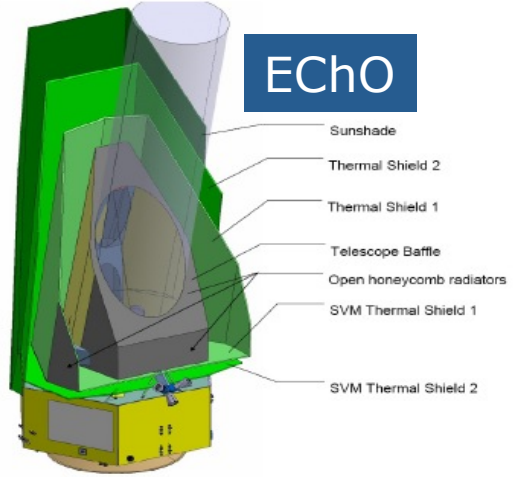
COSMIC VISION – Step 2

- Second "Call for Missions" issued in 2010
- Only M mission proposals solicited
- ECHO, Marco Polo, LOFT, STE-QUEST selected for assessment with PLATO (possibly) retained from previous round.
- Down-selection planned for 2013.





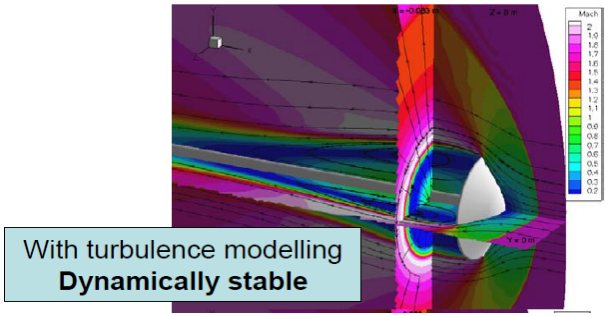




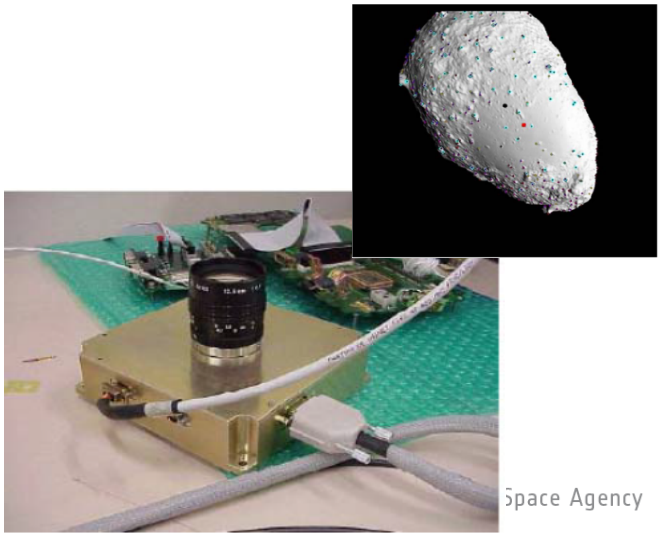
Key Technologies

Activities are well-ongoing or imminent

- **Re-entry**:
  - ✓ Heat shield material, currently TRL 5
  - ✓ Follow-on activity to start in June, TRL 6 target within 24 months
  - ✓ Crushable material activities
  - ✓ Capsule stability activity to confirm shape selection



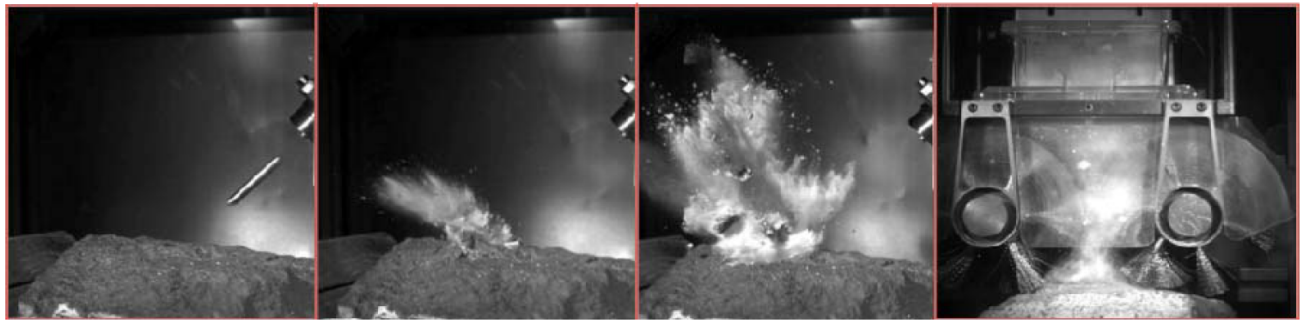
- **Descent/touchdown**:
  - ✓ Relative vision-based navigation, currently TRL 4/5
  - ✓ Follow-on activity to start in July, TRL 5/6 target within 18 months

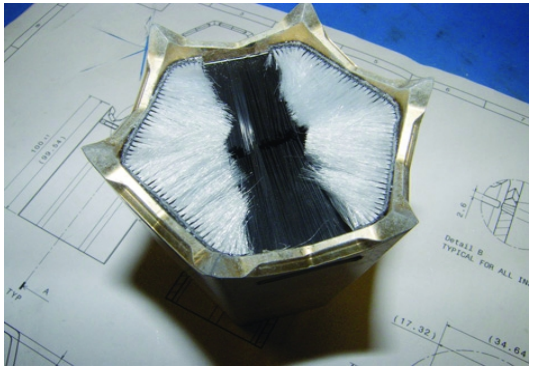


Key Technologies

- **Sampling:**
  - ✓ Sampling tool, currently TRL 3
  - ✓ Activity to start in July, TRL 5 target, including parabolic flight demo

- All activities aim to reach TRL 5-6 by early 2014, start of Phase B2/C/D
- In parallel, other TRP activities + payload DoI studies indirectly related to MP-R are ongoing

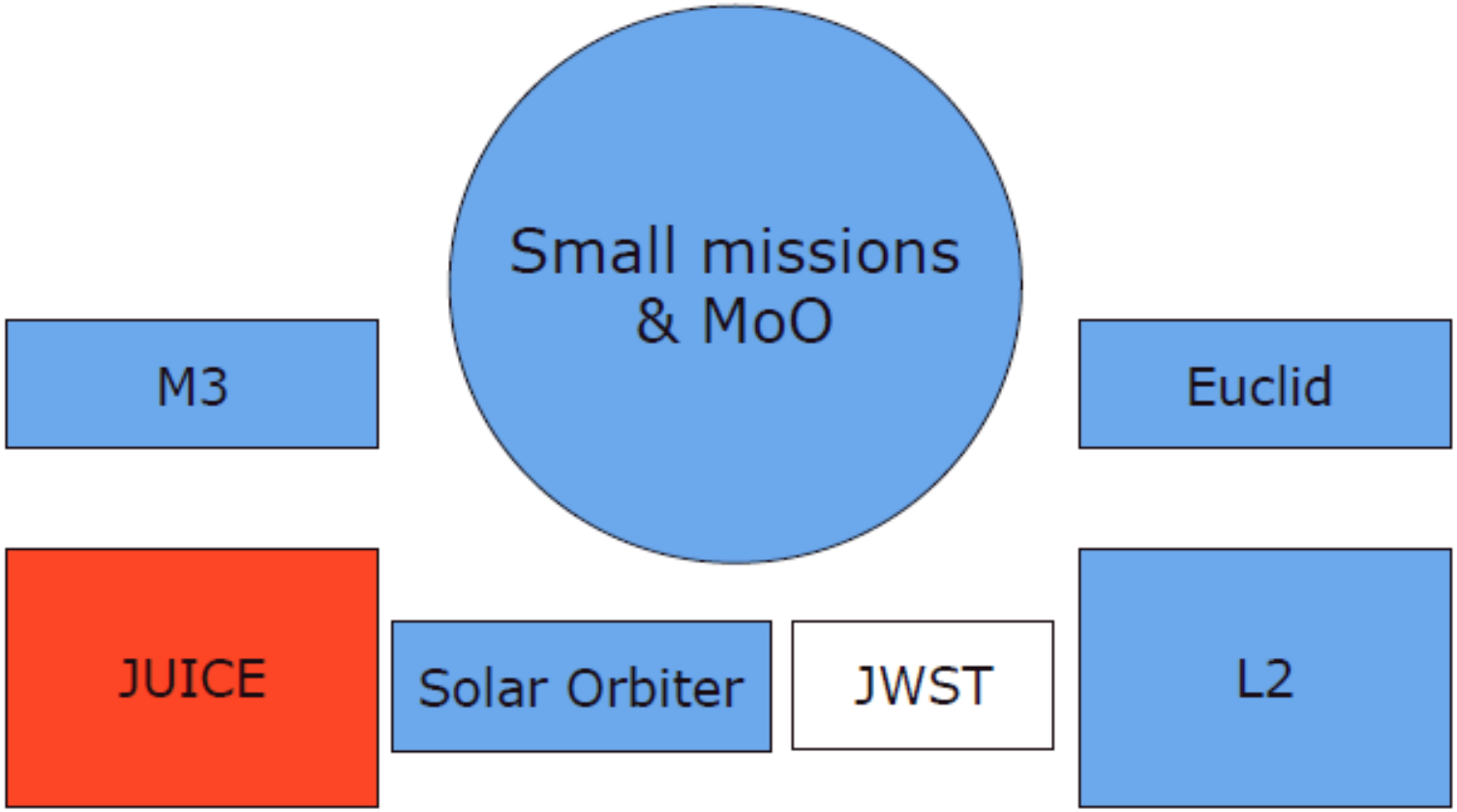




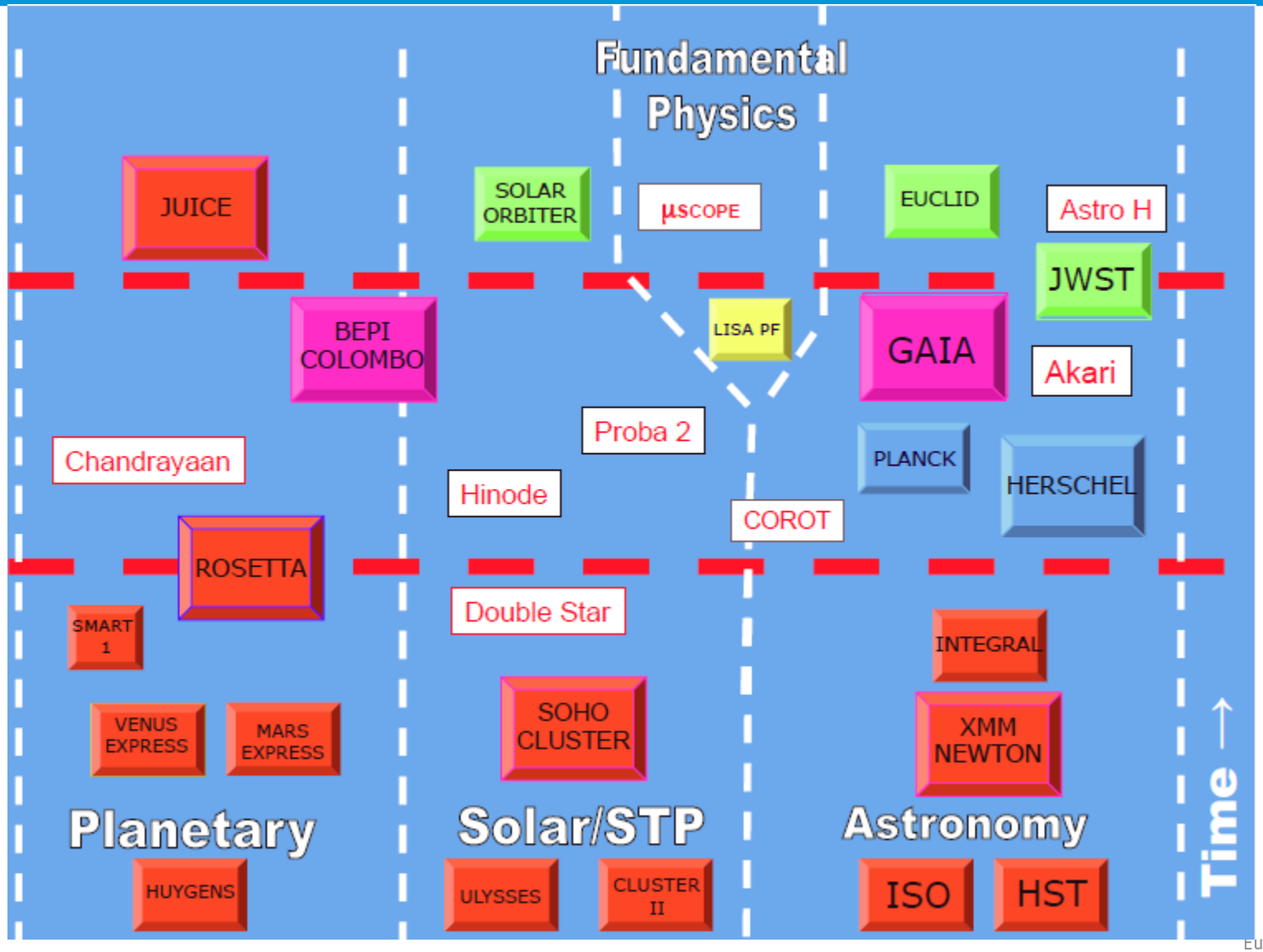
COSMIC VISION – Small Missions

- Novel component within the ESA Science Programme
- Call to the scientific community for novel ideas and explore approaches complementary to the current (L-M) components of the ESA Science Programme
- The Call imposes strict limits on the cost of the missions that can be implemented under the advertised scheme
- Small-size missions with a development time not exceeding 4 years
- Proposals can address all areas of space science
- Schedule:
  - LOI submission March 23, 2012 (12:00 CET)
  - Briefing meeting March 28, 2012
  - Proposal submission deadline June 15, 2012 (12:00 CET)
  - Proposal evaluation July - October 2012

COSMIC VISION First Slice (2015-2025)

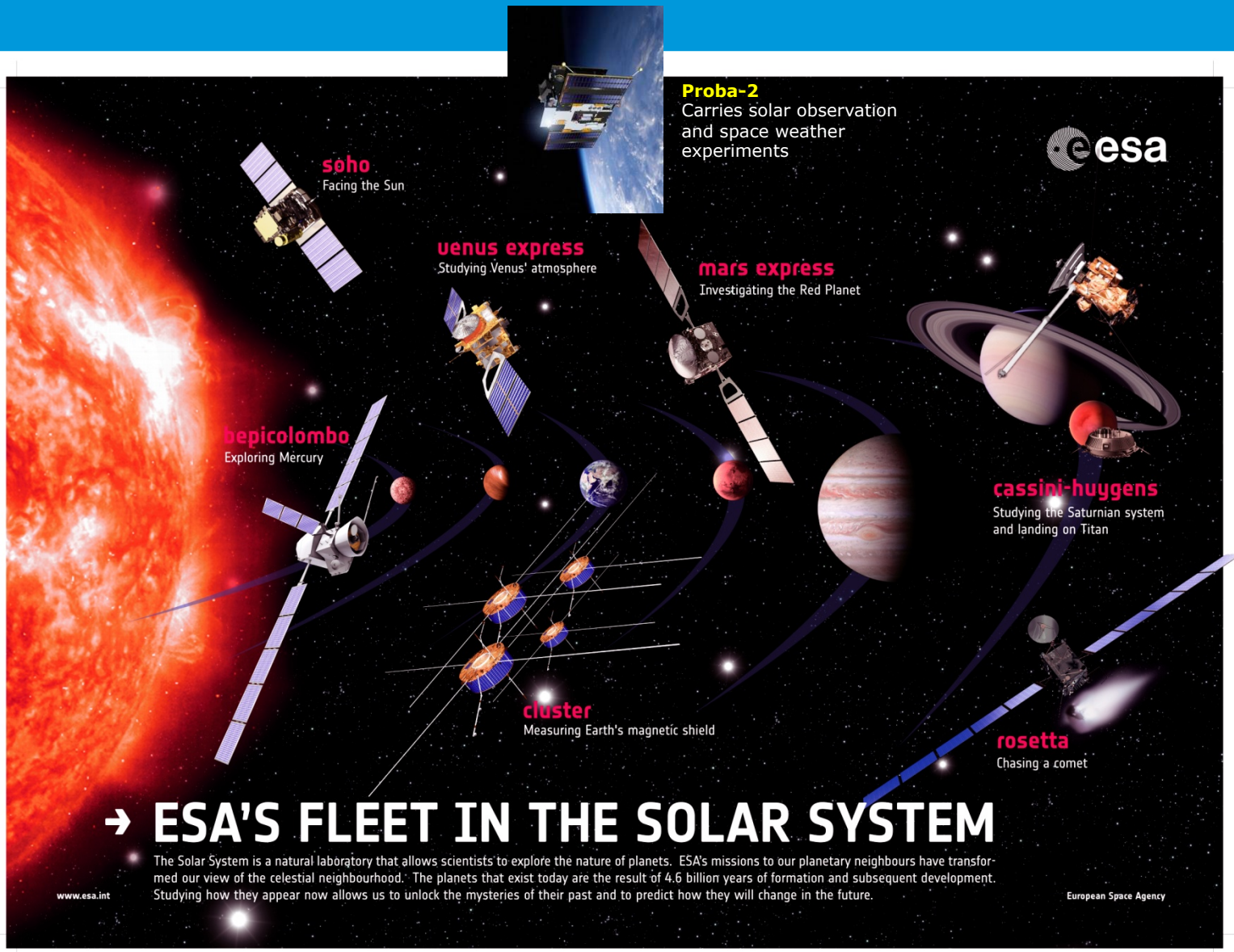


The Science Program today



The ESA fleet in the Solar System - Achievements

- The ESA Science Programme has consistently allowed European scientists to score key "firsts"
- Europe today has leadership in a number of fields in Space Science
- ESA aims at maintaining this leadership

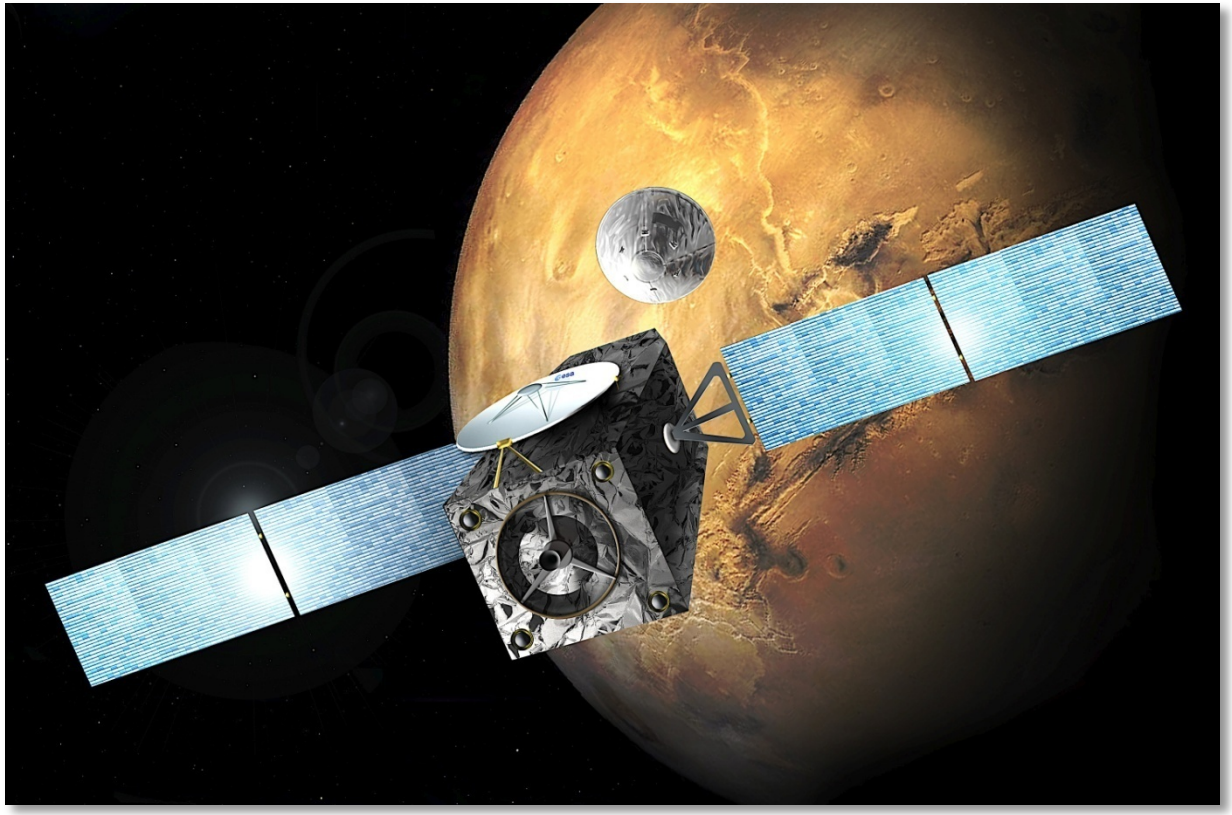


The (optional)
European Robotic Exploration Program

- Focused on the robotic exploration
- Optional program
  - Not all Member States participate
  - Individual missions are specifically funded by Member States
  - Based on international cooperation with Russia
- Two missions currently approved ("ExoMars")
  - Trace gas orbiter (TGO) and Entry, Descent, and Landing Demonstrator Module (EDM) (2016)
  - Exo-biology rover with Pasteur P/L (2018)
- Long-term goal is Mars Sample Return

The EDL Demonstrator Module

- A technology demonstrator for landing payloads on Mars
- A platform to conduct environmental measurements, particularly during the dust storm season



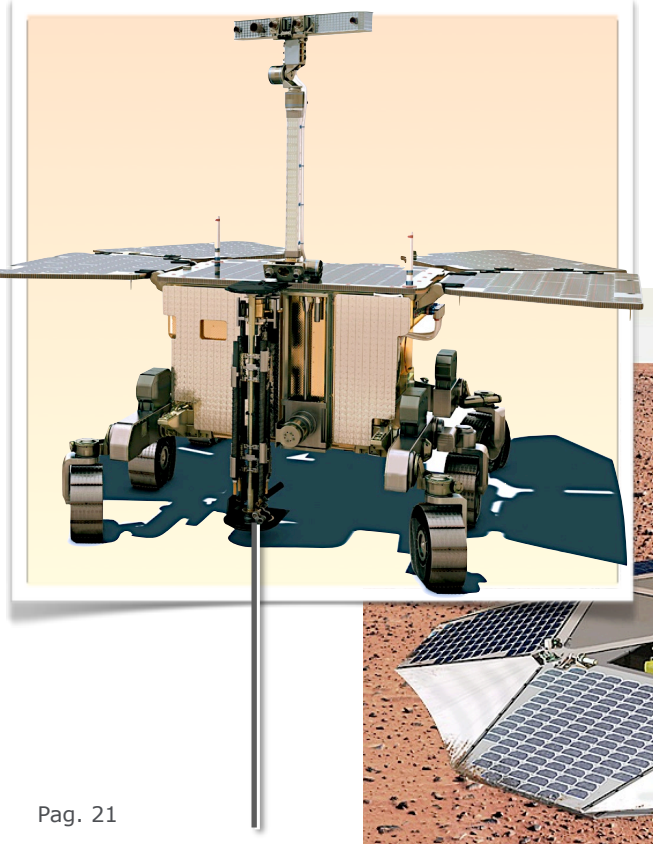
EDM PAYLOAD

- Integrated payload mass: 5 kg;
- Lifetime: 4–8 sols;
- Measurements:
  - Descent science;
  - P, T, wind speed and direction;
  - Optical depth;
  - Atmospheric charging;
  - Descent camera.

The 2018 Mission

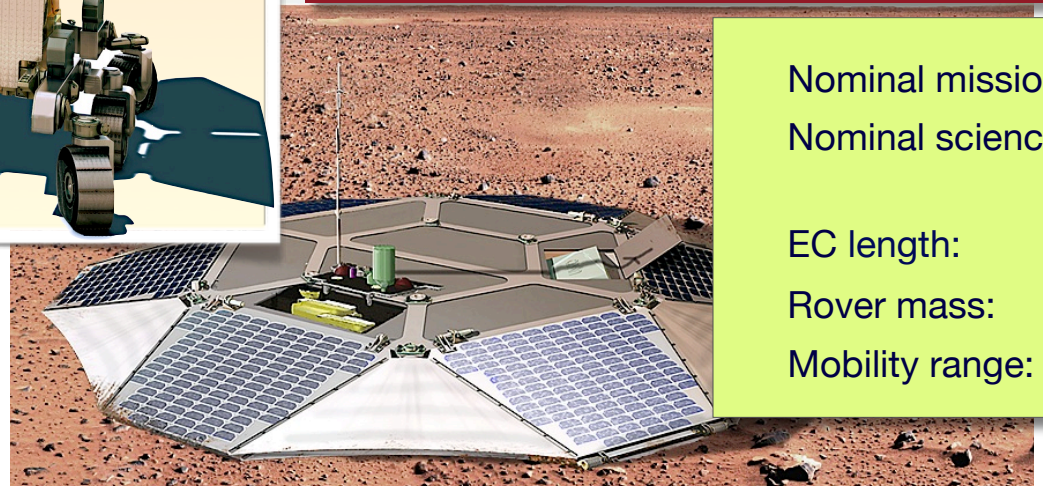
TECHNOLOGY OBJECTIVES

- Surface mobility with a rover (having several kilometres range);
- Access to the subsurface to acquire samples (with a drill, down to 2-m depth);
- Sample acquisition, preparation, distribution, and analysis.



SCIENTIFIC OBJECTIVES

- To search for signs of past and present life on Mars;
- To characterise the water/subsurface environment as a function of depth in the shallow subsurface.
- To characterise the surface and subsurface environment.



Nominal mission:	220 sols
Nominal science:	6 Experiment Cycles + 2 Vertical Surveys
EC length:	16–20 sols
Rover mass:	300-kg class
Mobility range:	Several km

The EREP perspectives
PHOOTPRINT & INSPIRE

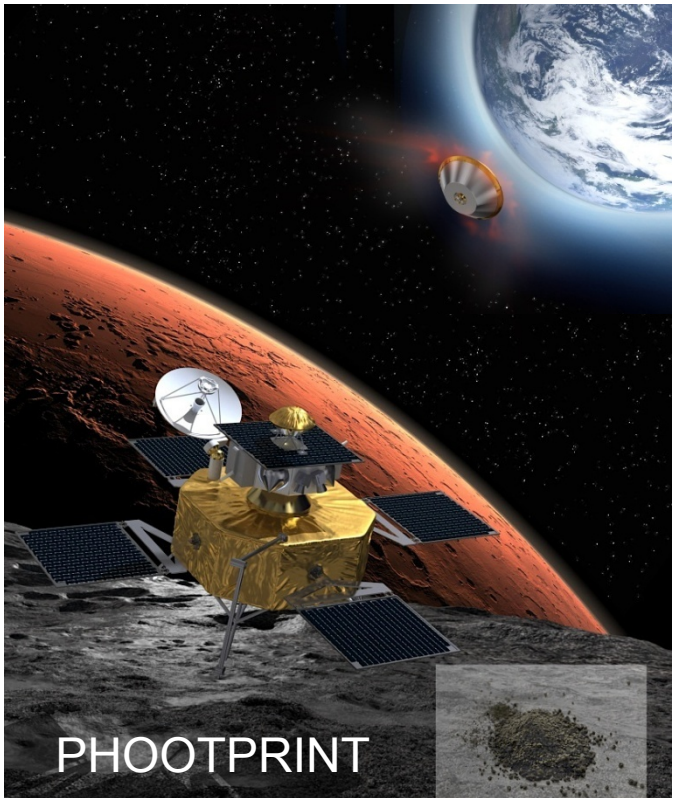
Missions with a strong scientific and technology content:

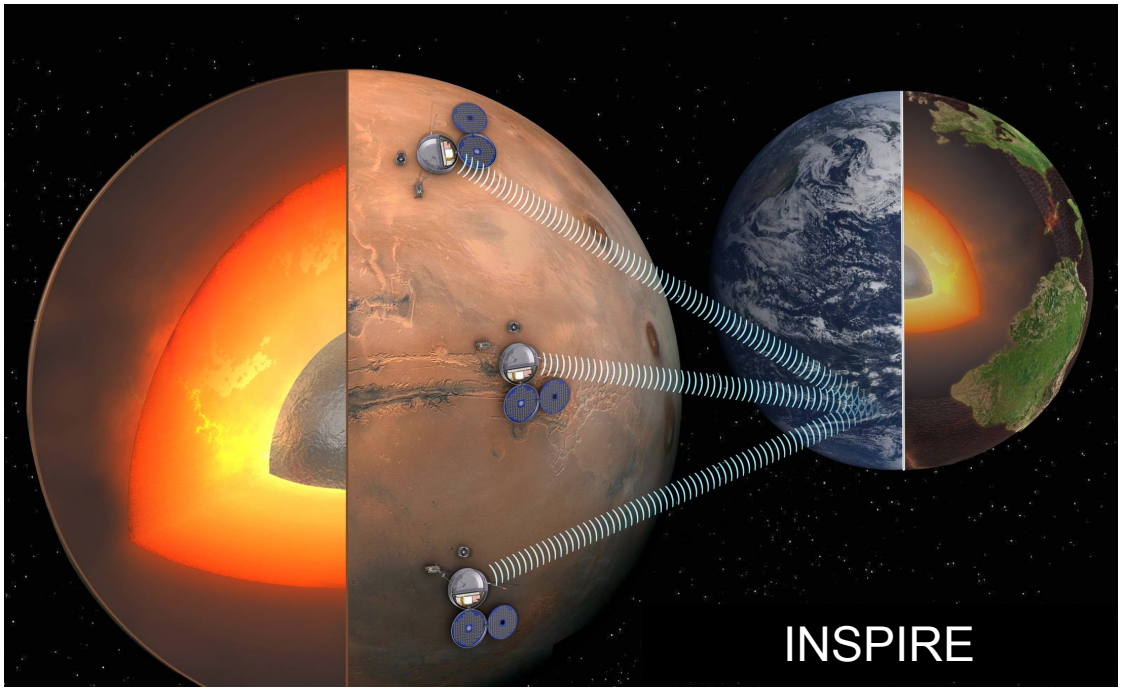
- Phobos sample return;
- Mars network.

New opportunities for international collaboration.

To be proposed at C-MIN 2012 for pre-development.

To be approved at C-MIN 2015 for implementation and launch.



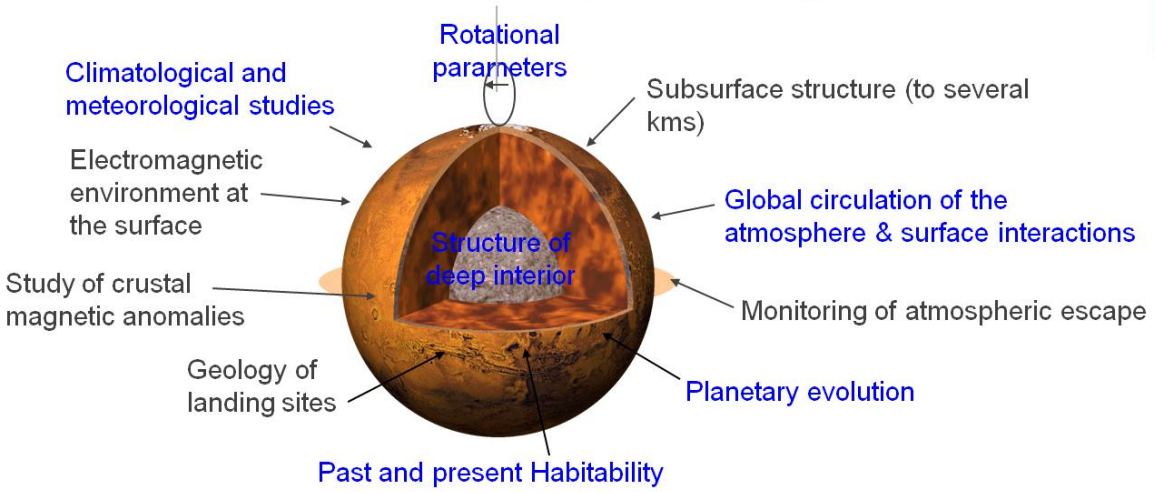


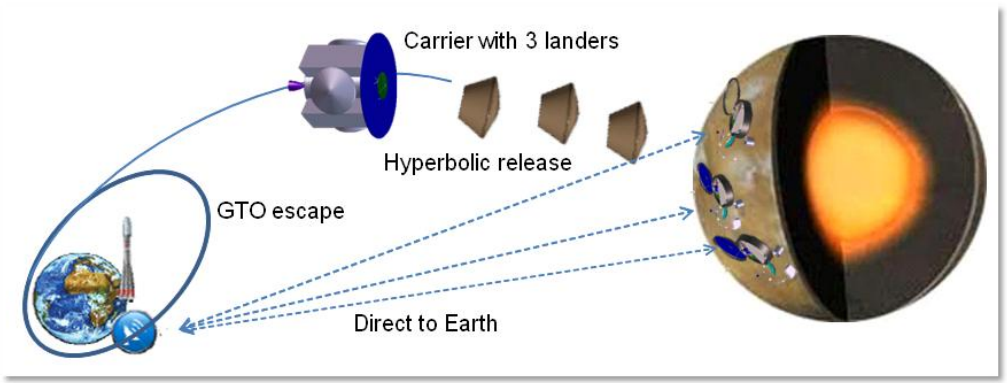
The EREP perspectives
PHOOTPRINT & INSPIRE

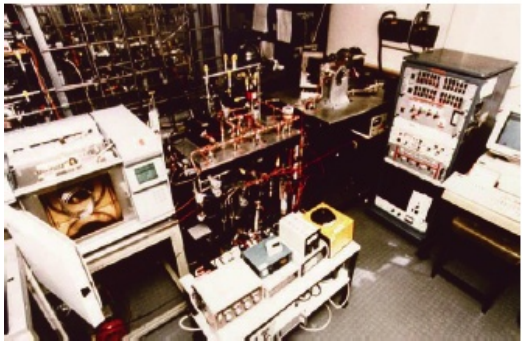
A network mission can address a broad range of scientific objectives:

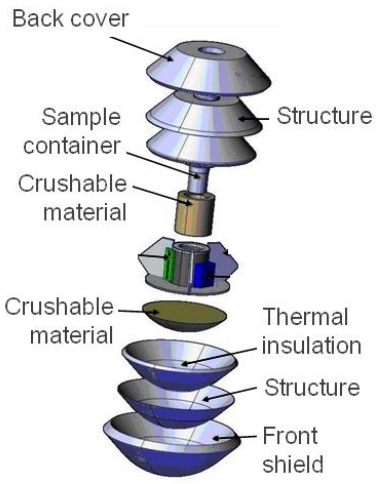
Network science objectives in blue.

In-Situ science goals in black.









Planning ESA's Science Programme

- Guidelines for a long-term programmatic view:
  a. Maintain scientific skills and expertise in Member States
  b. Maintain balance between the different scientific domains
  c. Define the long-term resources needed for a sustainable programme
  d. Allow for coordination with other agencies and national programmes
  e. Prepare technology plans and ground infrastructures
  f. Ensure a balanced industrial policy

- Flexibility
  - needed to respond to the evolving development of science and technology, both subject to unpredictable discoveries and serendipity

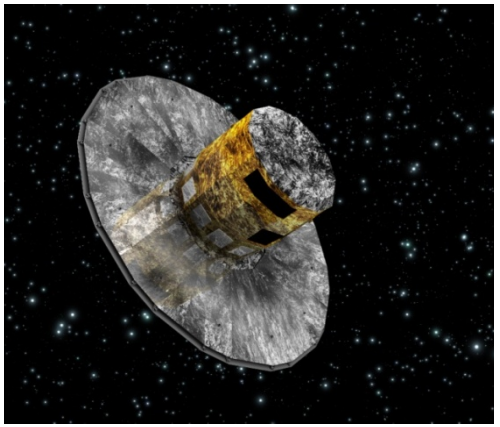
OBJECTIVES of the Long Term Scientific Program

- To provide the best space tools for the scientific community to achieve and sustain scientific excellence, leading the world with discoveries and innovation

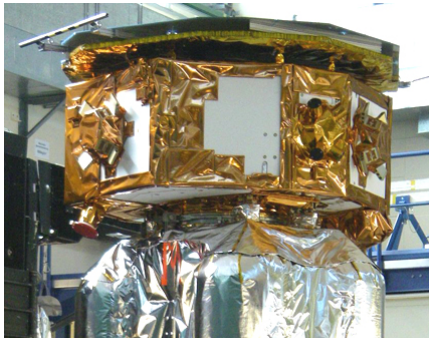
- To contribute to the sustainability of space skills and capabilities in Europe

OBJECTIVES for 2013-2015

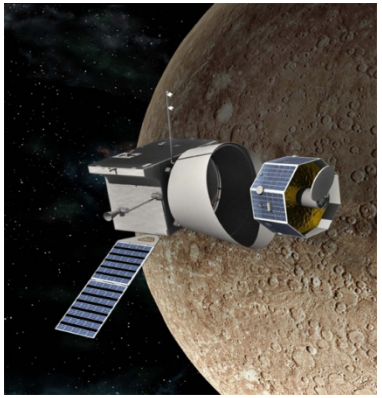
-2013: Launch of GAIA
Instruments for JWST delivered
Identification of L2 and L3
Selection of M3 and call for M4



-2014: Launch of LISA Pathfinder
Arrival of Rosetta to the comet Ch-G
Competitive review for mission extensions



-2015: Launch of BepiColombo
Call for Small Mission 2
Preparation of CM2015



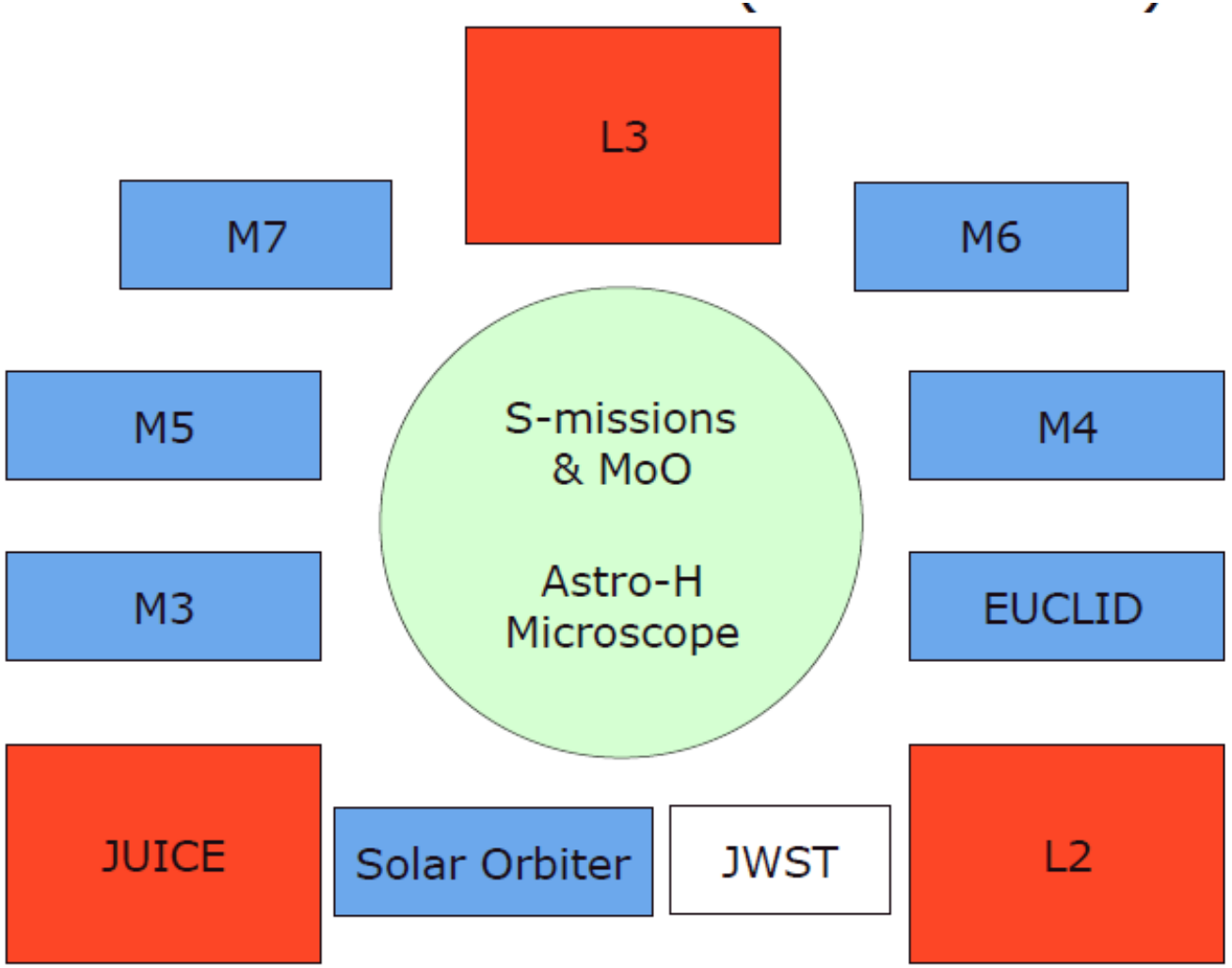
OTHER OBJECTIVES

- Affordable Cosmic Vision
- Periodical calls for M-missions (every 3 years)
- Budget stability and discipline
- Strict cost and calendar control
- Target of 1 launch per year (achievable with missions of opportunity and small missions)

CM 2012 – Revisiting Cosmic Vision

- ESA Science Program budget is decided at ministerial-level conferences with a 5 yr horizon
- Currently 3.5%/yr nominal budget increase
- Proposal for next ministerial in 2012: preservation of purchasing power in 2013-2017

COSMIC VISION (2015-2035)



COOPERATION

- **International cooperation:**
  a. Maintain cooperation with traditional partners (NASA)
  b. Consolidate partnership with Japan
  c. Consolidate cooperation with Russia
  d. Open cooperation with China
  e. Avoid cooperation at 50/50 level

- **Partnership with National agencies:**
  a. 30-40% of the programme with national contributions (instruments, their operation and exploitation)
  b. Specific calls for small missions to trigger cooperation between MS
  c. Missions of Opportunity (open to contribution to national projects)